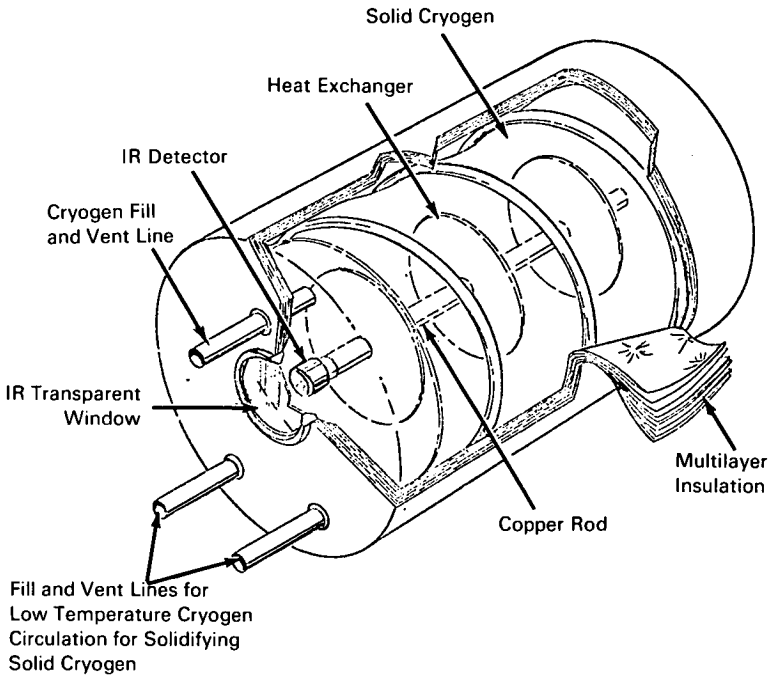
NASA TECH BRIEF

Development of Dual Solid Cryogens for High Reliability Refrigeration System



The problem:

To provide very low temperature cooling for time periods up to 1 year by means of a high reliability system having a low weight and volume. Spacecraft requirements in terms of weight, volume, and reliability are extremely stringent.

The solution:

The use of a low temperature (50° K) solid cryogen in conjunction with an efficient thermal protection system which utilizes a higher temperature, higher latent heat of sublimation solid cryogen in combination with a multilayer insulation system.

How it's done:

Basically, a solid cryogen refrigeration system consists of a container initially filled with a solid cryogen which is coupled thermally to an infrared detector by means of a link of high thermal conductivity extending from a heat exchanger within the cryogen container. The cryogen is chosen so that the desired detector temperature is maintained at some appropriate value by controlling the vapor pressure over the solid. Pressure control is achieved by controlling the venting rate of the subliming vapor to the surrounding space environment. All extraneous heat leaks to the solid cryogen must be eliminated in order that the

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principal thermal load on the solid cryogen is due to the infrared detector. This is accomplished by isolating the solid cryogen from its warm surroundings by means of a vacuum space filled with a multilayer insulation. A typical system is shown.

Notes:

1. A presently developed argon–carbon dioxide cryogen refrigerator system provides 17 mw of cooling at 52°K to an infrared detector with a total system weight of 34 pounds.
2. This type of refrigeration system may be useful in paramagnetic amplifier systems, radar systems, maser amplification systems, and spacecraft communications and reconnaissance systems, as well as spacecraft-borne microwave astronomy experiments, all of which require refrigeration in various temperature ranges.
3. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland 20771
   Reference: B67-10644

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: R. P. Caren and R. M. Coston
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